UTAH LAKE: THE PRICE OF PROGRESS

Learning to Distinguish Between Inference and Evidence

This lesson plan has been created as a resource for seventh grade teachers to teach the new core standards to their students. It integrates language arts standards in a meaningful and fun way. To see which specific standards are addressed, please refer to them below.

OBJECTIVE:

1. Students will be able to distinguish between inference and evidence.
2. Students will also be able to evaluate and present arguments for and against a claim.

STANDARDS ADDRESSED:

7th Grade Language Arts

7.RI.1 Reading Informational Text Standard 1:

Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.

7.RI.3 Reading Informational Text Standard 3:

Analyze the interactions between individuals, events, and ideas in a text (e.g., how ideas influence individuals or events, or how individuals influence ideas or events).

7.RI.8 Reading Informational Text Standard 8:

Trace and evaluate the argument and specific claims in a text, assessing whether the reasoning is sound and the evidence is relevant and sufficient to support the claims.

TEACHER BACKGROUND:

Review and become familiar with the information below which is taken from the pages of *Utah Lake: Legacy*.

FISHING. A WAY OF LIFE, A MEANS OF SURVIVAL. (From pg. 25)

Using seines (large nets) made of cotton yarn or flax; the pioneer fishermen caught thousands of pounds of Bonneville cutthroat trout, June sucker, Utah sucker, and chub. In 1848, fishing companies were organized to collect fish for desperate settlers who were without provisions. That year, frost killed early sprouting crops. Then came the crickets. Swarms destroyed many crops that survived the freezing temperatures, and hundreds of the valley's early residents stare starvation in the face. Were it not for the plentiful fish in Utah Lake, hundreds of settlers would have suffered severely. Several families were fortunate to have friends who were also skilled fishermen. The Hale family, for example, considered themselves lucky to know Lucas Hoaglund, who provided them with enough fish to survive a very rough year:

"[Hoaglund] used to go to Provo River with fishing parties, ketch fish [*sic*] and salt and dry them. They were very good and considered a rairaty [*sic*]."

More crickets would destroy pioneer crops in years to come. However, the worst attack wasn't executed by crickets, but by Rocky Mountain locusts, commonly known as grasshoppers. These tiny beasts weren't finicky eaters. They gobbled up wheat, corn, oats, barley, clover, grass – even clothing. They also ate almost everything in the typical backyard garden, including potatoes onions, peppers, rhubarb, beets, cabbages, radishes, and turnips. At times like these, when insects viciously took away what the earth so generously provided, the only thing left to do was fish. Motivated by hunger and the will to survive, settlers fished frequently and recklessly. Soon, laws were written to prevent the needless destruction of fish, to regulate fishing methods, and to control the number of fish being taken from the lake. But these laws were ignored by many locals, who seined night and day. Fishermen also placed stationary gill nets across the mouth of the Provo River. These nets indiscriminately caught thousands of fish – many of which were attempting to spawn.

"Indeed, so great was the number of suckers and mullets passing continuously upstream that often the river would be full from bank to bank as thick as they could swim for hours and sometimes days together." -- George Washington Bean, 1854.

CHANGE IS GOOD? (from pg. 26)

Very often, change is good. But in the 1880s, when carp were introduced to Utah Lake, the results weren't good at all. The intent was to replace the dwindling number of Bonneville cutthroat trout and to provide locals with a hardy fish that was also a very popular dish in other areas of the world. Yet, the newly integrated carp had long-lasting, negative impacts on the lake's native fish population. The carp's aggressive foraging habits eventually destroyed the pondweed on the surface and the plant life on the lake floor. This directly impacted the native fish populations. The reduced amounts of vegetation made it easier for waves to bring sediments up from the bottom, making the water more turbid and green in appearance. Most people didn't know it then, but high levels of sediments and nutrients fuel algae growth. If algae grows out of control, oxygen levels become too low for many fish to survive.

As the human population grew, so did competition for fish and water. Farmers needed water to irrigate fields, so dams and canals were built, many to redirect flows from the Provo River. At first, irrigation ditches were unscreened, so thousands of fish were carried into farmers' fields and stranded. Many of the townspeople gathered the fish for dinner. Other fish were left to fertilize crops. As a result of over-fishing, the introduction of nonnative fish, water depletion caused by irrigation, and later, the straightening, channeling, and dredging of its main tributaries, the health of the lake and its native fish began to decline.

"Fish were plentiful in those days in all streams around the Provo. We could get all we wanted when we irrigated our crops. There would be plenty of fish on the land after the water had suck into the ground." -- Clarence Merrill, 1850s.

(from pg 33)

The 1930s ushered in two destructive signs of the times: The Depression and drought. During this time, Utah Lake was receding as each year passed. By 1933, the Provo River had become narrow and shallow, and with a sandbar across its mouth, no large boats could pass through. The drought continued, and between 1935 and 1936, the water in the lake was too shallow for most boats to cruise. Utah Lake contained only 10,000 acre-feet of water that inadequately covered 20,000 acres. The surface area of Utah Lake, under normal conditions, is about 96,000 acres. The volume of water at that level is about 900,000 acre-feet, about one-third that is lost to evaporation each year.

Construction of the Provo Boat Harbor began in the 1930s with the purpose of replacing the defunct Provona Resort. When World War II began, the harbor was left unfinished, but after peaceful times returned, it was finally completed. With a secure place to park their boats, skippers from all over the state came to Utah Lake to race. The Memorial Day boat races were by far the most popular. These events drew spectators from far and wide to watch some of the fastest boats ever seen zip around the lake.

The Utah Lake State Park was born in 1967 when the state park system took over the Provo Boat Harbor from the city of Provo. New facilities were added, including a toll booth at the parks' entrance. Not surprisingly, the number of lake visitors dropped. People were so accustomed to freely accessing the beaches and picnic areas that they begrudged paying to get through the newly posted gate.

Industrial development brought more jobs and even more people to Utah County. The water in Utah Lake was in its worst condition, and recreation on the lake began to decline. People were beginning to see the damage that so many years of abuse had rendered. The effects of agricultural and industrial pollution and the deposition of raw and treated sewage did more than keep swimmers away; they also had negative impacts on the native fish community. As the 1960s and 1970s progressed, signs warning swimmers not to go into the water were posted. Most of the recreational resorts were closed by that time. Convincing swimmers, campers, boaters, and water skiers to recreate at Utah Lake was a sales pitch that fell on deaf ears.

THE PRICE OF PROGRESS (from pg. 37)

The abuse of Utah Lake's tributaries and ecosystem began earlier than most people realize. Beginning in the 1890s and continuing into the 1950s, raw sewage was drained into the creeks and streams flowing into the lake. Also in the 1880s, sugar mills deposited waste from the processing of sugar beets into the tributaries of the lake and the Jordan River. Sawmills were guilty, too. Instead of paying to have sawdust removed with team and wagon, owners dumped it into the streams that ran into lake tributaries and the Jordan River. The sawdust got lodged in the gills of trout and suffocated large numbers of them. Cottonwood, Nebo, Santaquin, and Payson Creeks were among the streams affected.

The waste disposal practices of the mills were in violation of an 1872 law passed by the Territorial Legislature. This law made it illegal to put any deleterious substances that would kill fish and pollute culinary water into public streams. Legislators, concerned citizens, and the recently formed Utah Fish and Game Protective Society worked together to pressure mill owners into obeying the law.

Several agricultural practices had devastating effects on the lake's native fishes and their habitat. Fertilizer run-off into drainage ditches, which caused phosphates to seep into the lake, was part of the problem. Yet, many believe the most staggering losses of fish occurred as a result of irrigation. Unscreened irrigation ditches carried thousands of fish into farmers' fields to die. Irrigation diversion dams along rivers and streams presented insurmountable barriers for spawning fish. They hindered the spawning runs of many sucker and trout, and directed newly hatched fish into irrigation ditches instead of back to the lake.

In 1872, lawmakers worked to correct the problem dams by passing a law requiring owners of all new structures to install fishways, which would allow fish to pass over dams that blocked their spawning runs. In 1874, the law was amended to include existing dams as well. Today, fishways are no longer required and diversion dams still prevent June sucker from accessing suitable spawning grounds.

Utah's economic development progressed into the 1900s when the steel industry came to Utah Valley via the newly constructed railroads. Columbia Steel Corporation's Ironton Plant started operations in the 1920s. The plants provided jobs for eager workers and transported steel products to various parts of the country by train. Geneva Steel began operations in 1942 and became a magnet for jobseekers of all levels, from the manufacturing floor to the upper stations of engineering and management. The company caused a sharp population increase and helped spark the local economy, but the steel industry wasn't good for the lake. Steel plants were accused of severely polluting the water. They later worked to repair the damage by funding extensive cleanup efforts.

THE LAKE THEN AND NOW (from pg. 38)

In the 1970s, a study led by Dr. Willis H. Brimhall of Brigham Young University found that Utah Lake was less turbid in pioneer times. Brimhall's study noted that since its inception, the lake has never been perfectly clear because it has always been shallow. This lack of depth contributes to its turbidity, large loss of water to evaporation, slightly saline water, warm summer temperatures, and an abundance of algae. Brimhall also concluded that some 28 feet of sediment accumulated on the lake's bottom over the past 10,000 years. The rate of sedimentation has doubled since the first settlement and the later urbanization of Utah Valley.

In the 20th century, the increased amounts of fertilizer and sewage that were dumped into the lake fueled algae growth, harmed the quality of water, and damaged the habitat of the native fish. Urban growth around the lake has increased erosion, and the carp population has stripped

the lake of nearly all of its aquatic vegetation. These factors, combined with the lake's historically shallow depths, have kept the water in a turbid state.

In recent years, the introduction of more nonnative fish, including predators such as white bass, has also contributed to the demise of the lake's ecosystem and native fish community. White bass compete with native fish like June sucker for food and also prey upon sucker young. Nonnative carp, which currently comprise 90 percent of the fish biomass (weight) in the lake, destroy the vegetation on the lake's bottom. This leaves less cover to protect June sucker from predators. With so many obstacles placed in the reproductive path of this native fish, it's no surprise that most June sucker found in the lake today are estimated to be between the ages of 20 and 43 years old.

Utah Lake attracts boaters, anglers, duck hunters, kayakers, water skiers, and campers. However, recreational use is low compared to other lakes and reservoirs in Utah. Anglers cast their lines for channel catfish, walleye, white bass, black bass, and different species of panfish. The lake will always be a special place for the many generations who have enjoyed it over time, and it is a critical resource for local residents. Water is distributed for irrigation and residential use from the lake's drainage basin through tributaries like the Provo, Spanish Fork, and American Fork rivers, and the Jordan River outlet. The lake's tributaries remain the primary source of fresh water for much of the ever-growing population of the Wasatch front. Clearly, for more reasons than most people realize, we need Utah Lake. And perhaps even more importantly, it needs us.

A TIME TO HEAL. (from pg. 38)

Municipal and industrial discharge, urban growth, and poor land use practices have impaired water quality and severely damaged the June sucker's only indigenous habitat. The recovery of June sucker and the revitalization of Utah Lake go hand-in-hand. A healthy habitat for the fish benefits the entire ecosystem of the lake and the people who live around it. There is a great need to improve habitat for both fish and animals, and to control the nonnative fish populations so that the lake and its rivers can once again host a balanced fish community. Also, water supplies must be managed to meet the needs of fish and other species without interrupting water service to human residents.

Working together, we can restore Utah Lake to become a better home for the June sucker and a more efficient water resource for our communities. Ultimately, a restored habitat will enable this extraordinary fish to live and breed in its only natural home. Improving Utah Lake will also allow for the continued use of its water to meet the needs of our growing population – be it for necessity or for pure fun.

FISH TROUBLE. (from pg. 50)

Both humans and Mother Nature contributed to the demolition of Utah Lake's native fish community. In 1872, a dam was constructed across the Jordan River (the Lake's only outlet) for using the lake as a storage reservoir. In the coming decades, the high-mountain reservoirs were created to retain increased springtime runoff. Some of these reservoirs still exist and continue to provide water to the Wasatch Front for agriculture, industry, recreation, and municipalities.

The reservoirs and irrigation practices mentioned earlier initiated a gradual change in Utah Lake's water quality, and this resulted in the deaths of many fish. Return flows from irrigation raised the lake's water temperatures and increased turbidity. Thousands of tons of sucker died during the drought of the 1890s, when rivers were drained in an effort to water parched fields. These actions left fish stranded on dry river beds to perish. A severe drought in the early 1930s prompted farmers to dewater the Provo River in a futile attempt to save their dying crops. At the same time, Utah Lake shriveled to an alarming average depth of one foot. Scientists later concluded that the native fish population never fully recovered from the effects of such catastrophic droughts and the continuing practices of poorly managed irrigation.

FROM PLENTIFUL FISH TO ENDANGERED SPECIES. (from pg. 51)

In addition to the careless fishing and irrigation, methods practiced by man, the merciless acts of nature, the introduction of exotic or nonnative species of fish has played a major role in the demise of June sucker. In the past 100 years, more than 20 species have been mixed with the native fish of Utah Lake. These new species include common carp, largemouth bass, black bullhead, channel catfish, walleye, white bass, and others. After rebounding from the 1930s drought, a significant decrease in sucker numbers was documented in the mid-1950s. Scientists hypothesized that the primary reason for the decline was the result of young sucker falling prey to white bass and walleye.

Today, June sucker young continue to be an easy meal for white bass and other predators. Historically, June sucker traveled further up the Provo River or other tributaries to spawn, but today, the lower Provo River is the only area where June sucker are known to spawn successfully. Suckers possess no jumping ability to progress past even the smallest of barriers, let alone the irrigation diversion dams on the Provo River. These obstacles prevent spawning sucker from migrating further than 4.9 miles upstream. When their young drift downstream from the safe haven of the lower Provo River on their way back to the lake, the young fish's chances of living long are very slim. Predators like white bass need not travel far to intercept these small June sucker.

Thousands of trout and sucker died in 1872 and in later years, when killing fish with what was then called "giant powder" (now referred to as dynamite) became common. After a law was passed creating a trout seining season, it was illegal for fishermen to net trout during spawning

runs. But the public kept its taste for trout, so unscrupulous fishermen decided that if they couldn't seine for large amounts of trout during the closed season, they would blast. Such a cruel method of catching fish created protests from citizens throughout the Wasatch Front. After passing and overturning several blasting laws with varying degrees of punishment, dynamiting fish became a felony in 1896. A hefty fine was levied on offenders from that year until the turn of the century. The thought of parting with money was too much to bear for many offenders. As a result, the frequency of blasting decreased.

DOWN BY THE OLD MILLSTREAM. (from pg. 75)

Mill owners of the late 1800s and early 1900s joined the assault on water quality by regularly dumping sawdust and other forms of waste into the tributaries of Utah Lake and the Jordan River. Large numbers of trout suffocated when the sawdust clogged their gills. Public outcry led to legislative law, which helped control the problem, but serious damage had already been done.

The Provo Woolen Mills, a cooperative formed by shareholders belonging to the LDS Church, helped the local economy grow. However, the dye, lanolin, and other waste from the mill's manufacturing process also went into the mill race, which ran into the Provo Bay on Utah Lake. Near the beginning of the 20th century, Telluride Power announced plans to deliver electricity to the Mercur mines on the lake's west side. To accomplish this feat, the company said it would be necessary to build a large dam, up to 84 feet in height, across the Provo River just above Bridal Veil Falls. Provo residents protested. Among their many complaints, the issue of a dam creating serious problems for spawning fish was overlooked. Permission to build the large dam was denied, but Telluride was later given the go-ahead to construct a smaller dam. Later when sportsmen discovered that spawning trout could not get over the dam, the company built a fall and pool system of water-filled tanks. The system was designed to help trout swim over the dam and progress on their spawning routes, but residents deemed the system ineffective. In efforts to satisfy both fish and people, Telluride built, at their own expense, three more fishways in quick succession. None of these worked. Finally, with the advice of Washington, D.C. fish experts, and the approval of Utah County officials, Telluride built a fifth fishway. This final fishway was the company's last attempt to please everyone.

VALLEY OF STEEL. (from pg. 78)

California wasn't the only place where the riches of the earth could be found. Gold, silver, lead, zinc, and copper were all mined in and around Utah County. The expansion of the railroads enabled shipments of dynamite to enter the valley. As more mine tunnels were blasted, previous timber was taken from the surrounding mountainsides and cut into massive wooden beams. These were used to support the tunnels in an effort to avoid cave-ins. As greater areas of forest were cleared, the earth that had been held in place by trees filtered into Utah Lake, contributing to the water's turbidity.

The railroads not only kept busy hauling the products of the growing mining industry to cities throughout the west, they also helped usher the steel industry into Utah County. In the early 1900s, trains made available the essentials for steelmaking – iron ore from Iron County, and coal from Carbon and Emery counties. In the early 1920s, Columbia Steel Corporation's Ironton Plant took advantage of these plentiful resources and began producing steel.

Later, a larger and more versatile steel mill was built near Utah Lake. From 1941 to 1944, 10,000 workers labored to build a $200 million, federally financed facility near the old Geneva Resort, for which the plant was named. Geneva Steel's purpose was to ensure that both military (the plant supplied steel for ship building in California during World War II) and industrial needs for steel would be met. The location near Orem was chosen for several reasons. The essential raw materials were all within reach in addition to readily available coal and iron ore supplies, limestone, and dolomite were found near Payson, and water could be drawn from Deer Creek Reservoir and from on-site artesian wells. The company could also recruit from an educated and stable local work force. And, because the plant was situated inland, it would likely be protected from attacks by enemy warplanes.

Geneva Steel not only provided lucrative jobs to hundreds of local people, it also drew many easterners to work at the plant. Such a sudden increase in population instigated a residential building frenzy. Utah Valley communities seemed to expand overnight as 4,500 new residents arrived. The local economy was prospering, but the water in Utah Lake began to suffer. Increased amounts of raw sewage from Provo and other cities were being funneled into Provo Bay and Utah Lake. The influx sparked a need for new utility services and sewage management.

Perceptions of Utah Lake's condition steadily became more negative. In the 1940s and early 1950s, Provo residents experienced a polio scare. People knew raw sewage was being emptied into the lake, and they connected exposure to that waste with the proliferation of polio. As more people comprehended the apparent link, the public became alarmed. Wastewater treatment facilities were established to help ensure only treated waste was deposited into Utah Lake, but not many minds were put at rest. Only the development of the Salk vaccine helped calm nerves.

Changes were not only taking place around the lake, but to the lake itself. During the height of steel production, Geneva Steel, like many other steelmakers, failed to recognize the importance of environmental protection and contaminated the lake with hazardous materials. In the 1940s and 1950s, the needs of the environment simply were not the urgent issues they are today. As a result, Geneva Steel failed to initiate significant environmental practices until the early 1990s. Geneva Steel struggled for years as global competition in the steel industry reduced the company's profit margins. The plant filed for bankruptcy in 1999 and later closed.

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Learning to Distinguish Between Inference and Evidence

TEACHER MATERIALS:

- Excerpts above from the *Utah Lake: Legacy* book
- Utah Lake Legacy video Chapter 5, Chapter 7
- Choose a few excerpts from the teacher background information.
  - One will be used as a whole class discussion on distinguishing between inference and evidence.
  - The teacher can decide which other excerpts will be used for the student activity.
  - You may choose to use several excerpts to give students different information.

STUDENT MATERIALS:

- Colored pencils (two colors per person).
- Excerpt for class discussion.
- Excerpt for student activity.

PROCEDURE:

1. Place students into groups or pairs.

2. With the class, discuss the difference between an inference statement and an evidential statement.

   a. Example of inference: The Hobble Creek Restoration Project has increased the aquatic vegetation in the area increasing the opportunity for June sucker to spawn.
   Example of evidence: In October 2010, aquatic vegetation was found growing in areas where it had not been previously found for decades.

3. Pass out the excerpt selected for the whole class to discuss. Mark the inferences and evidences with different colored pencils. Please note special attention between the human interaction and the outcome.

4. Pass out the other chosen excerpts to the students for the student activity. Give some time to the students to read and mark their excerpts. You may decide to group the students at tables with similar excerpts.

5. After students have read and marked their excerpts, pose the following questions:

   a. Has human influence on Utah Lake been positive or negative? What about today's influences?

b. Have the students make a list of statements both positive and negative influences and evidences from their excerpts as a small group/pair. Have them choose their strongest argument either positive or negative by circling the statement.

c. Share responses as a class debate and record arguments on the board. The teacher provides an evaluation of each argument by a plus or minus, if it is a good or bad argument. Teacher should explain each excerpt is different and may not have a strong argument. (The purpose of evaluating is to encourage students to think about the problem presented and the quality of their statement).

d. Class Debate Format
   i. Invite one group to share their strong argument/statement.
   ii. Invite another group to use their list of statements to provide evidence or inference that supports or refutes the claim.
   iii. Continue until arguments are exhausted on that topic and begin again with a new strong argument or statement.

6. Optional -- Watch Chapter 5 and/or Chapter 7 of *Utah Lake: Legacy* or watch Utah Lake: Carp Removal

ASSESSMENT:

- Check the students' proper responses for textual evidence and inferences.

EXTENSIONS:

- Different questions could be posed -- Should we save the June sucker?
- Students may find articles that support or refute the claims in the excerpts provided.

Delta upgrades equal healthier lake and more fun time

In the wake of the recently completed Hobble Creek Delta restoration at Utah Lake, Local officials are currently conducting a feasibility study towards the restoration of the Provo River Delta. What does it all mean and why should you care? We spoke with Mike Mills, a restoration coordinator with the June Sucker Recovery Project to find out. In short, delta restoration leads to a healthier lake environment, more wildlife, and greater recreational use.

Utahlake.gov: For those who might have forgotten from middle school, what are deltas in a general sense and why are they important?
Mike Mills: Deltas are geologic features that typically form at the transition from a river environment to a lake environment. Deltas are important because they support a wide variety of healthy vegetation and wildlife.

How far along is the Provo River Delta feasibility test?
The study has focused on gathering as much information we can about the natural delta that existed historically and the various resources that could be affected by the project. It is also becoming more obvious how important the Provo River is to the residents of Utah Valley. Many people enjoy the lower river for the recreational benefits that it provides. As we have analyzed the various options for a delta, it appears that we are going to be able to enhance the recreational opportunities available.

Tell me about the Hobble Creek Delta restoration.
The Hobble Creek delta restoration involved the purchase of about 21 acres of property near the mouth of Hobble Creek. The actual restoration started with developing a design for the project that would allow for the creek to function in a natural way and accommodate those processes that would allow for a dynamic delta to exist. A key aspect of this restoration was to create a situation where the natural river and lake processes could work to change and maintain the delta. The entire construction of the project took three months.

Delta upgrades equal healthier lake and more fun time

For us June sucker recovery folks, one of the biggest benefits has been the increasing number of June sucker that have been able to use Hobble Creek for spawning and the wetland ponds have provided suitable habitat for young June sucker. Prior to the restoration, June sucker were not able to swim up Hobble Creek because of debris and other problems associated with the old channelized river.

While the June sucker benefits are great, the project has really benefitted the entire Hobble Creek ecosystem. The delta has become a hotbed of wildlife activity, with species from American avocets to mule deer being observed on the property. Recreational users have also re-discovered Hobble Creek, as anglers, bird watchers, and people walking their dogs have all started using the site much more than we anticipated.

How might the Provo River Delta restoration differ from Hobble Creek?

The Provo River is several times larger than Hobble Creek, with an average maximum flow that is four times that of Hobble Creek. As such, the Provo River delta will need to be much larger than the Hobble Creek delta in order to accommodate all of the natural processes that must occur in order for the delta to function properly. With this larger size, I am somewhat hopeful that the Provo River delta will be able to accommodate more recreational amenities. It would be nice to be able to include more improved trails as part of the Provo River project and perhaps facilities like a bird observation tower, trailheads/parking, a picnic facility and maybe unimproved boat ramps.

As it pertains to Provo River, why should residents care?

As I mentioned previously, the Provo River is a very important resource to the residents of Utah Valley. Many people enjoy it for its recreational aspects, but it also enhances the quality of like in the valley through its existence and the ecological functions it maintains. The lower river provides irrigation water, habitat for plants and animals, conveys storm water, and is an aesthetic resource. There is also the possibility of providing the public with access to recreational opportunity that is not currently available.

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